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(71) Applicants
Tokico Ltd.,
6—3 Fujimi 1-chome,
Kawasaki-ku, Kawasaki-shi, Kanagawa-ken, Japan
(72) Inventor
Seiji Toda
(74) Agents
Langner Parry,
52—54 High Holborn,
London WC1V 6RR

(54) Hydraulic damper and air spring unit

(57) A hydraulic damper and air spring unit including a generally vertical cylinder member 2, a piston working in the cylinder member and having a piston rod 3 slidingly projecting from the upper end of the cylinder member, a first tubular member 9 connected to the piston rod and having an upper closed end and an open lower end, a second tubular member 12 connected to the cylinder member and having a lower closed end and an upper open end, and a flexible tubular member 11 with opposite ends being connected respectively to the first and second tubular members. The diameter of the first tubular member 9 is smaller than that of the second tubular member 12. The flexible tubular member has coaxial first and second wall portions connected respectively to the first and second tubular members and an intermediate rolling wall portion which is convex in the upward direction. The arrangement allows water to be easily drained from the rolling diaphragm air spring, and the diaphragm is not caused to roll over debris which may accumulate on the cylinder.

Fig. 1

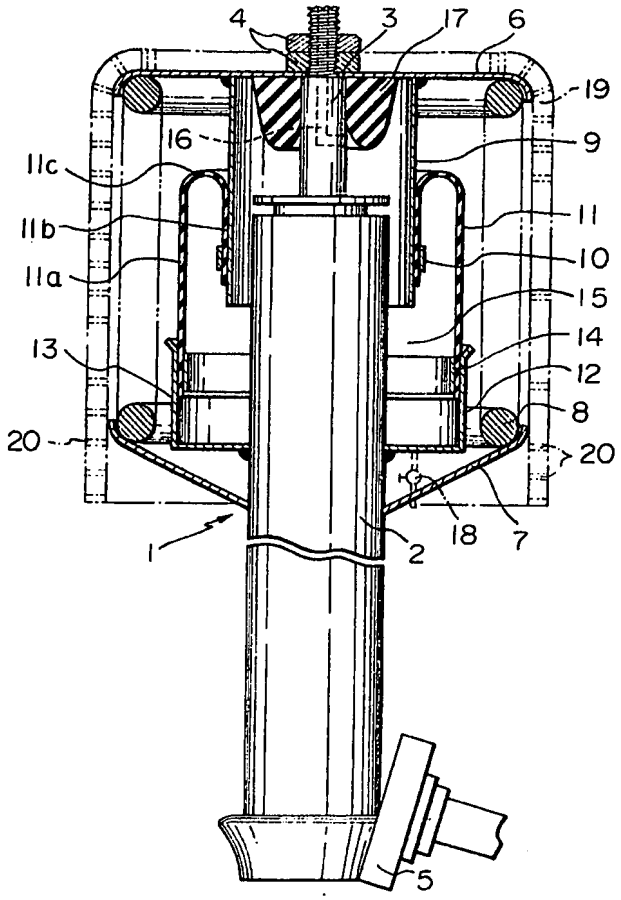

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Fig. 1

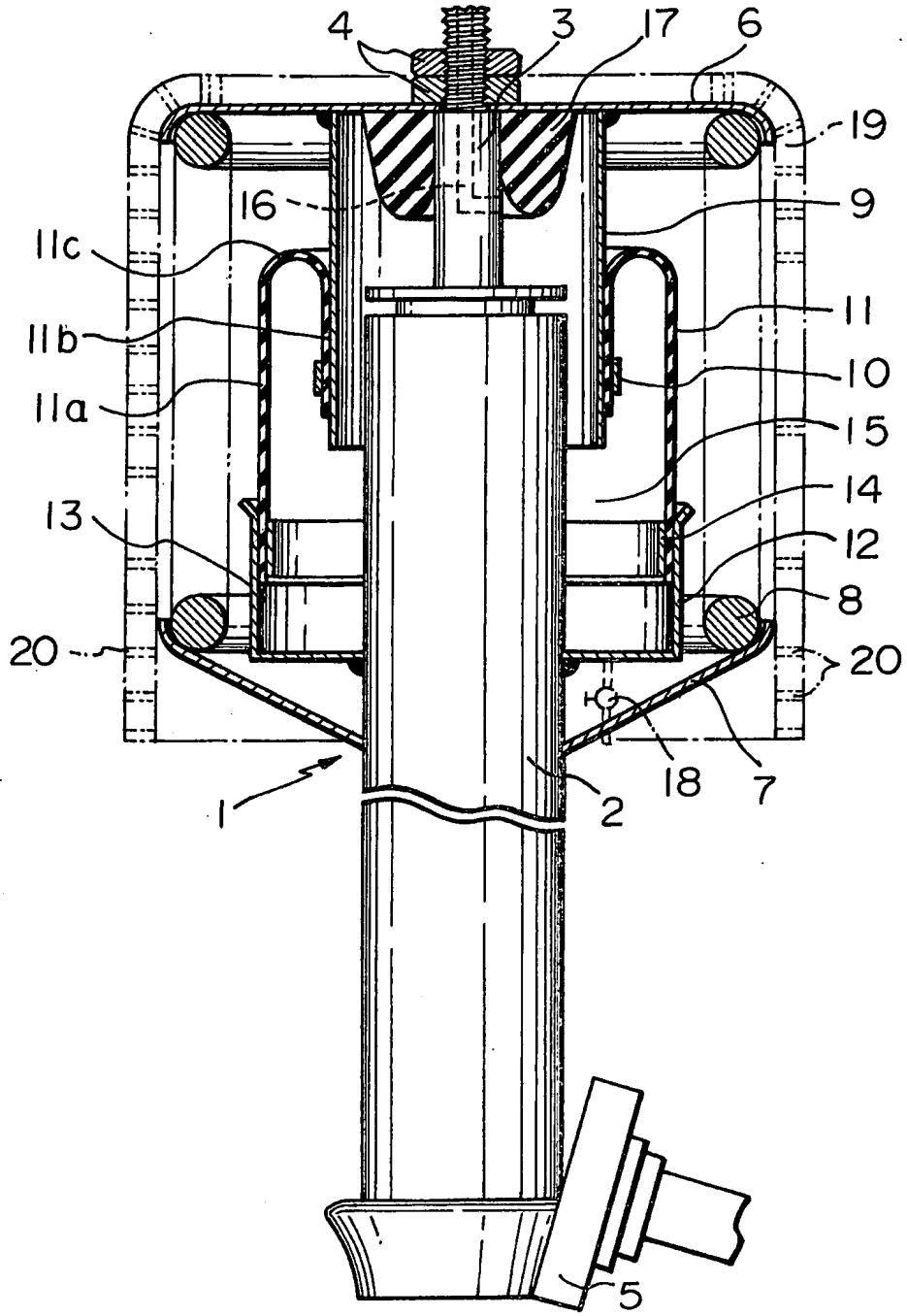
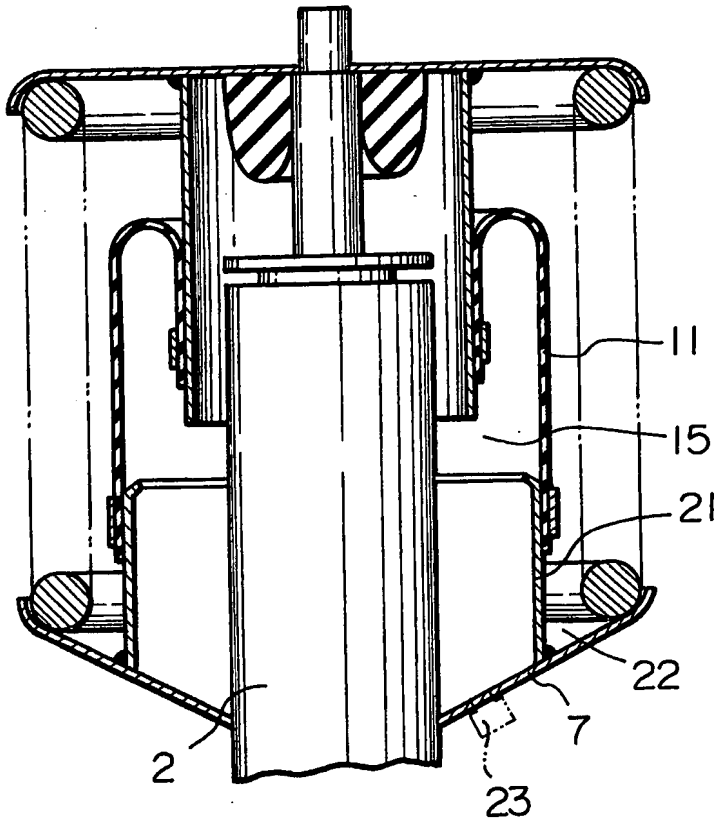


Fig. 2



SPECIFICATION

Hydraulic damper and air spring unit

This invention relates to a hydraulic damper and air spring unit for use in a suspension system of a vehicle having a height adjusting device.

The height adjusting device acts to maintain the height of the vehicle such as an automobile at a predetermined level irrespective to the loading condition of the vehicle and, usually, the device is associated with air spring in the suspension system of the vehicle so as to increase or decrease the air pressure in the air springs in response to the loading condition of the vehicle.

The hydraulic damper and air spring unit is particularly adapted for use in combination with the vehicle height adjusting system and, usually, comprises: a hydraulic damper having a cylinder member, a piston working in the cylinder member and a piston rod secured to the piston and slidingly projecting from one end of the cylinder member; and an air spring defined by a resilient and flexible tubular member with one end being secured to the outer circumference of the cylinder member of the hydraulic damper, and the other end of which being secured to a generally cup shaped tubular member which is secured to the projecting end of the piston rod of the hydraulic damper and surrounds the piston rod, whereby an air chamber is defined by the cup shaped tubular member and the flexible tubular member. Such device is shown in such as U.S. patent specifications 3,046,001 and 3,967,363.

The upper end of the piston rod of the device is usually connected to the sprung mass such as a chassis of the vehicle and the lower end of the cylinder member is connected to the unsprung mass such as a wheel shaft, thus, foreign materials such as mud, stone or the like tend to accumulate on the outer periphery of the cylinder member and, since the flexible tubular member usually has a first wall portion extending along the outer circumference of the cylinder member, a second wall portion coaxially surrounding the first wall portion and a rolling wall portion connecting the first and second wall portion, the contacting area between the first wall portion and the outer circumference of the cylinder member changes in response to the extension or contaction of the piston rod, therefore, foreign materials such as muds, stones or the like accumulated on the outer circumference of the cylinder member tend to be clamped between the cylinder member and the flexible tubular member thereby causing damage in the flexible tubular member which is usually formed of rubber or the like. Further, the rolling wall portion of the flexible tubular member has a downwardly convex configuration and depends from the first and second wall portions which are respectively connected to the cylinder member and the cup shaped tubular member, thus, a drain water will sometimes accumulate on the inner surface of the rolling wall portion and it is difficult to efficiently remove the drain water.

The present invention aims to remove aforementioned shortcomings in prior art device and provides a hydraulic damper and air spring unit which comprises a generally vertical cylinder member adapted to be connected with such as a wheel shaft of a vehicle, a piston rod slidingly projecting from the upper end of the cylinder member and adapted to be connected with a chassis of the vehicle, a first tubular member surrounding the piston rod with upper closed end therof being secured to the upper end of the piston rod and the lower end thereof opening in the downward direction, a second tubular member having the diameter larger than that of the first tubular member and surrounding the cylinder member with lower closed end thereof being secured to the cylinder member and the upper end thereof opening in the upward direction, and a resilient tubular member with the opposite ends thereof secured respectively to the first tubular member and to the second tubular member to define an air chamber, the resilient tubular member having a first tubular wall portion extending along the circumference of the first tubular member, a second tubular wall portion coaxial with the first wall portion and a rolling wall portion connecting the first and second wall portion, and being convex in the upward direction.

Therefore, according to the invention, it is possible to minimize the foreign materials being clamped between the resilient tubular member and the cylindrical or tubular member thereby preventing the damage or aging of the resilient tubular member and, to easily drain the water accumulated in the air chamber.

The invention will hereinafter be explained in detail with reference to attached drawings exemplifying two preferred embodiments of the invention.

In the drawings:

Fig. 1 is an explanatory longitudinal sectional view of a hydraulic damper and air spring unit according to the invention, and

Fig. 2 is an explanatory view of another embodiment of the invention.

In Fig. 1, shown at 1 is a hydraulic damper consisting of a cylinder member 2 containing therein hydraulic fluid and a piston rod 3 connected to a piston (not shown) working in the cylinder member 2. The piston rod 3 slidingly and sealingly projects through the upper end of the cylinder member 2. Various types of hydraulic dampers have been proposed and are well known for those skilled in the art and, since the invention does not relate to the detailed construction of the hydraulic damper, the detailed description is omitted.

The piston rod 3 has a reduced diameter screw threaded portion on the projecting end thereof and nuts 4 screw-threadingly engage therewith and, further, the projecting end portion is connected to a chassis (not shown) of a vehicle. A knuckle sprindle 5 is secured to the lower end of the cylinder body, whereby the hydraulic damper 1 is mounted between the chassis and a wheel shaft of the vehicle. A coil spring 8 is interposed

between an upper spring retainer 6 which is secured to the projecting end of the piston rod 3 and a lower spring retainer 7 which is secured to the outer circumference of the cylinder member 2. The coil spring 8 coaxially surrounds the hydraulic damper 1. A tubular member 9 is secured to the upper spring retainer 6 to coaxially surround the piston rod 3. The tubular member 9 cooperates with the upper spring retainer 6 to constitute a first tubular member according to the invention which has a closed upper end and an open lower end.

One end of a resilient and flexible tubular member 11 is secured to the outer circumference of the tubular member 9 by clamping the resilient tubular member 11 between the tubular member 9 and a retaining ring 10.

The other end of the resilient tubular member 11 is secured to a second tubular member 12 which has a closed bottom secured to the outer circumference of the cylinder member 2, and a tubular portion 13 coaxially surrounding the cylinder member 2. The resilient member 11 is clamped between the tubular portion 13 and a retaining ring 14. It will be noted that the diameter of the second tubular member 12 is larger than that of the first tubular member 9.

The resilient member 11 is formed to have a first tubular wall portion 11b extending along the first tubular member 9, a second tubular wall portion 11a coaxial with the first wall portion and extending upwards from the second tubular member 12, and a rolling wall portion 11c connecting the first and second wall portions 11a and 11c. The rolling wall portion 11c is convex in the upward direction.

The resilient member 11 cooperates with first and second tubular members 9 and 12 to define an air chamber 15 which acts as an air spring. An air supplying/exhausting passage 16 is provided in, for example, the piston rod 3 for supplying or exhausting pressurized air into or from the air chamber 15. Shown at 17 is a buffer member secured to the spring retainer 6 and is formed of such as rubber and acts to prevent the cylinder member 2 from directly impacting with the spring retainer 6. A protecting tube 19 having a plurality of openings 20 is secured to the spring retainer 6 which surrounds the spring 8 and extends downward of the spring retainer 7.

In operation, when the vehicle is heavily loaded and the height thereof decreases, the height adjusting device detects the change in the height and supplies pressurized air in to the air chamber 15 through the passage 16 thereby restoring a predetermined height level. When a load on the vehicle is demounted the height of the vehicle increases, and the height adjusting device exhausts a part of pressurized air in the air chamber 15 and the predetermined height level is maintained.

According to the invention, the tubular member 9 is located on the upper portion of the unit and the resilient tubular member 11 surrounds the tubular member 9 and is convex in the upward direction, thus, it is possible to effectively prevent the accumulation of muds, stones or the like on the outer circumference of the tubular member 9 thereby reducing foreign materials being clamped between the tubular member 9 and the resilient member 11. The tubular member is convex in the upward direction, and a tubular member 12 is secured to the cylinder body 2, thus a drain valve 18 can easily be mounted on the tubular member 12 which enables to drain the water accumulated in the air chamber 15 as required.

It will be noted that US patent specification 3,363,893 discloses a device having the functional effect similar to the invention in preventing foreign materials from entering into contacting area between the resilient tubular member and the rigid tubular member, and the general construction of the device is similar to that of the invention. However, the first tubular member connected to the piston rod has the diameter larger than that of the second tubular member connected to the cylinder body, and is disposed radially outwards or overlaps the second tubular member by a substantial axial length. The resilient tubular member extends along the inner circumference of the first member and along the outer circumference of the second member with the rolling wall portion being convex in the upward direction. The arrangement is disadvantageous in that since the rolling wall portion is convex toward the interior of the pressure chamber, the resilient tubular member receives the pressure as compressive force which requires to increase the thickness of the resilient tubular member and to decrease the difference in the diameter between the first and second members. Further, the drain water accumulated in the air chamber cannot easily be exhausted.

Fig. 2 shows a modified form wherein a tubular member 21 is secured to the spring retainer 7 to constitute the second tubular member 22 according to the invention. A plug 23 is directly mounted on the spring retainer 7 to drain the water accumulated in the pressure chamber 15.

As described heretofore, according to the invention it is possible to minimize the aging, deformation or damage of the resilient flexible tubular member which would be caused of foreign materials such as muds, stones or the like being accumulated or retained in the space between the resilient tubular member and a rigid tubular member and, further, it is possible to easily remove the drain water in the air chamber.

CLAIMS

1. A hydraulic damper and air spring unit comprising a generally vertical cylinder member adapted to be connected with such as a wheel shaft of a vehicle, a piston rod slidingly projecting from the upper end of the cylinder member and adapted to be connected with such as a chassis of the vehicle, a first tubular member surrounding the piston rod with upper closed end thereof being secured to the upper end of the piston rod and the lower end thereof opening in the downward

direction, a second tubular member having the diameter larger than that of the first tubular member and surrounding the cylinder member with lower closed end thereof being secured to the cylinder member and the upper end thereof opening in the upward direction, and a resilient and flexible tubular member with the opposite ends thereof secured respectively to the first tubular member and to the second tubular member to define an air chamber, said resilient tubular member having a first tubular wall portion extending along the circumference of the first tubular member, a second tubular wall portion coaxial with the first wall portion and a rolling wall portion connecting the first and second wall portion, and being convex in the upward direction.

2. A hydraulic damper and air spring unit as set forth in Claim 1 wherein a spring retainer is also secured to the cylinder member and separately from the second tubular member.

3. A hydraulic damper and air spring unit as set forth in Claim 1 wherein said second tubular member is integral with a spring retainer.

4. A hydraulic damper and air spring unit as set forth in Claim 1 wherein a drain valve is provided on the lower end of the second tubular member.

5. A hydraulic damper and air spring unit substantially as hereinbefore described with reference to, and as illustrated in Fig. 1 or Fig. 2 of the accompanying drawings.

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